

60V(D-S) N-Channel Enhancement Mode Power MOS FET

General Features

- $V_{DS} = 60V, I_D = 0.3A$
 $R_{DS(ON)} < 3\Omega @ V_{GS}=5V$
 $R_{DS(ON)} < 2\Omega @ V_{GS}=10V$
 ESD Rating: HBM 2300V

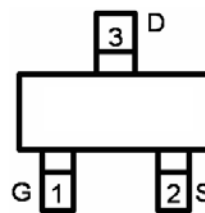


Lead Free

- High power and current handling capability
- Lead free product is acquired
- Surface mount package
- ESD protected

Application

- Direct logic-level interface: TTL/CMOS
- Drivers: relays, solenoids, lamps, hammers, display, memories, transistors, etc.
- Battery operated systems
- Solid-state relays

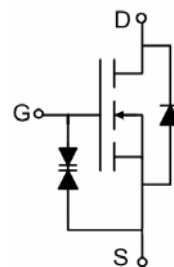


Marking and pin assignment

PIN Configuration



SOT-23 top view



Schematic diagram

Package Marking And Ordering Information

| Device Marking | Device | Device Package | Reel Size | Tape width | Quantity |
|----------------|----------|----------------|-----------|------------|------------|
| | MSN7002E | SOT-23 | Ø180mm | 8 mm | 3000 units |

Absolute Maximum Ratings ($T_A=25^\circ C$ unless otherwise noted)

| Parameter | Symbol | Limit | Unit |
|--|----------------|-------------------|------------|
| Drain-Source Voltage | V_{DS} | 60 | V |
| Gate-Source Voltage | V_{GS} | ± 20 | V |
| Continuous Drain Current ($T_J=150^\circ C$) | I_D | $T_A=25^\circ C$ | 0.3 |
| | | $T_A=100^\circ C$ | 0.19 |
| Drain Current-Pulsed (Note 1) | I_{DM} | 0.8 | A |
| Maximum Power Dissipation | P_D | 0.35 | W |
| Operating Junction and Storage Temperature Range | T_J, T_{STG} | -55 To 150 | $^\circ C$ |

Thermal Characteristic

| | | | |
|--|-----------------|-----|--------------|
| Thermal Resistance, Junction-to-Ambient (Note 2) | $R_{\theta JA}$ | 350 | $^\circ C/W$ |
|--|-----------------|-----|--------------|

Electrical Characteristics (T_A=25°C unless otherwise noted)

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|---|---------------------|---|-----|------|------|------|
| Off Characteristics | | | | | | |
| Drain-Source Breakdown Voltage | BV _{DSS} | V _{GS} =0V I _D =250μA | 60 | 68 | - | V |
| Zero Gate Voltage Drain Current | I _{DSS} | V _{DS} =60V, V _{GS} =0V | - | - | 1 | μA |
| Gate-Body Leakage Current | I _{GSS} | V _{GS} =±10V, V _{DS} =0V | - | ±100 | ±500 | nA |
| | | V _{GS} =±20V, V _{DS} =0V | - | ±4 | ±10 | uA |
| On Characteristics (Note 3) | | | | | | |
| Gate Threshold Voltage | V _{GS(th)} | V _{DS} =V _{GS} , I _D =250μA | 1 | 1.7 | 2.5 | V |
| Drain-Source On-State Resistance | R _{DS(ON)} | V _{GS} =5V, I _D =0.4A | - | 1.3 | 3 | Ω |
| | | V _{GS} =10V, I _D =0.5A | - | 1 | 2 | Ω |
| Forward Transconductance | g _{FS} | V _{DS} =10V, I _D =0.2A | 0.1 | - | - | S |
| Dynamic Characteristics (Note 4) | | | | | | |
| Input Capacitance | C _{ISS} | V _{DS} =25V, V _{GS} =0V, F=1.0MHz | - | 21 | 50 | PF |
| Output Capacitance | C _{OSS} | | - | 11 | 25 | PF |
| Reverse Transfer Capacitance | C _{rss} | | - | 4.2 | 5 | PF |
| Switching Characteristics (Note 4) | | | | | | |
| Turn-on Delay Time | t _{d(on)} | V _{DD} =30V, I _D =0.2A V _{GS} =10V, R _{GEN} =10Ω | - | 10 | - | nS |
| Turn-on Rise Time | t _r | | - | 50 | - | nS |
| Turn-Off Delay Time | t _{d(off)} | | - | 17 | - | nS |
| Turn-Off Fall Time | t _f | | - | 10 | - | nS |
| Total Gate Charge | Q _g | V _{DS} =10V, I _D =0.3A, V _{GS} =4.5V | - | 1.7 | 3 | nC |
| Drain-Source Diode Characteristics | | | | | | |
| Diode Forward Voltage (Note 3) | V _{SD} | V _{GS} =0V, I _S =0.2A | - | - | 1.3 | V |
| Diode Forward Current (Note 2) | I _S | | - | - | 0.2 | A |

Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board, t ≤ 10 sec.
3. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.
4. Guaranteed by design, not subject to production

Typical Electrical And Thermal Characteristics

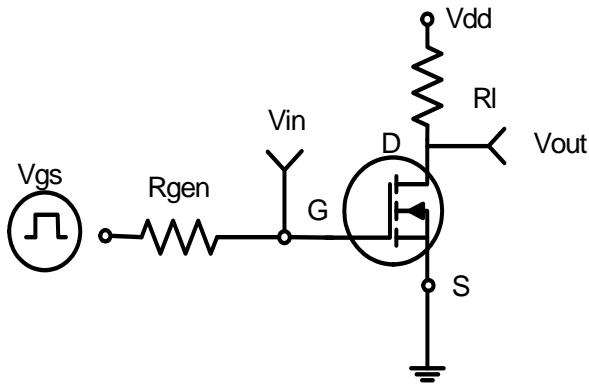


Figure 1: Switching Test Circuit

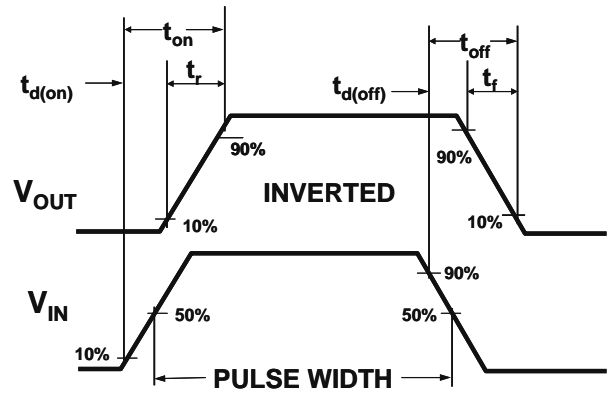


Figure 2: Switching Waveforms

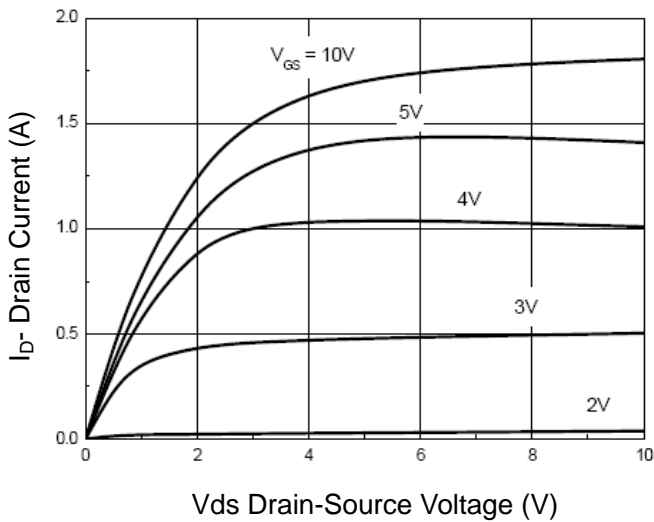


Figure 3 Output Characteristics

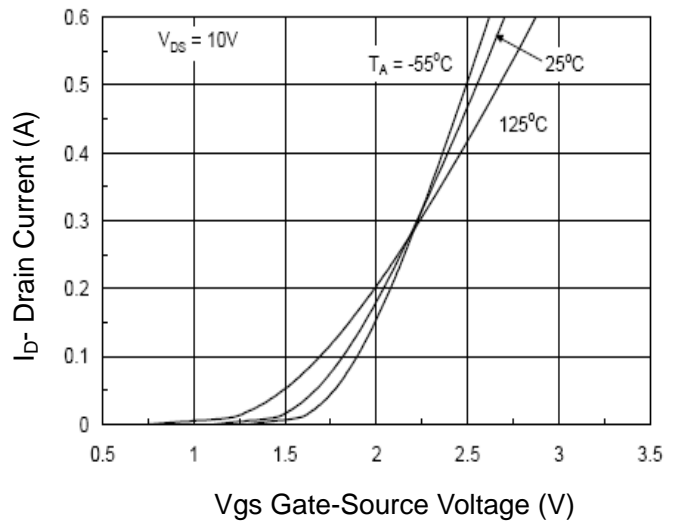


Figure 4 Transfer Characteristics

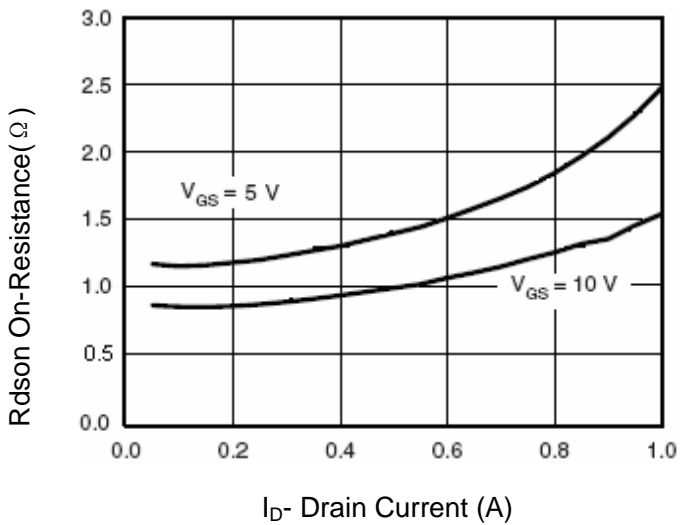


Figure 5 Drain-Source On-Resistance

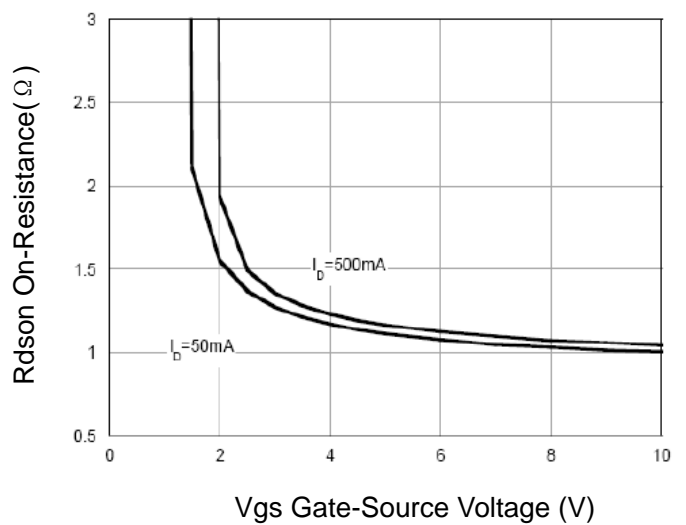


Figure 6 Rdson vs Vgs

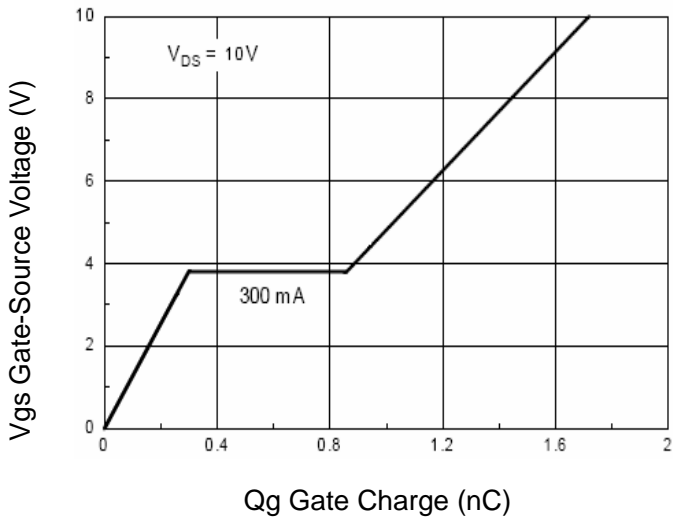


Figure 7 Gate Charge

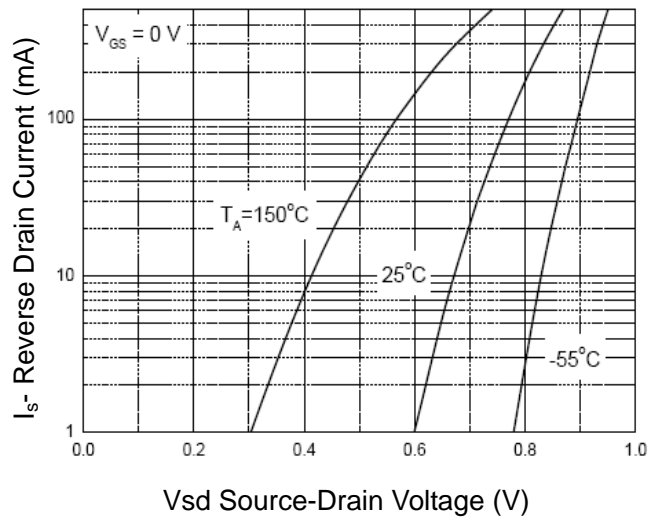


Figure 8 Source-Drain Diode Forward

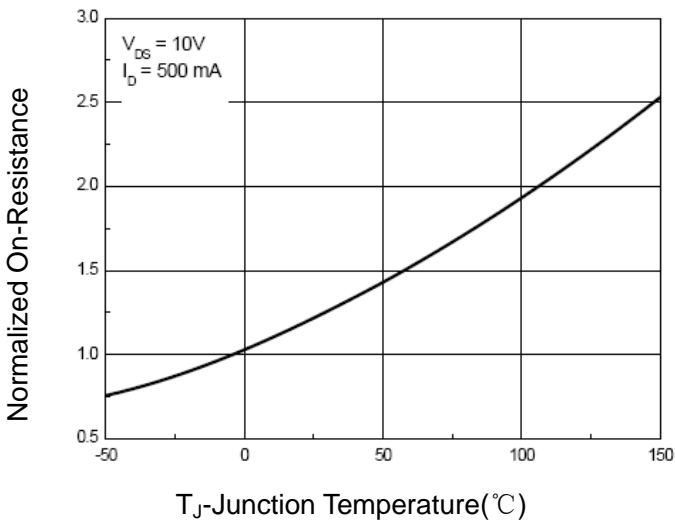


Figure 9 Drain-Source On-Resistance

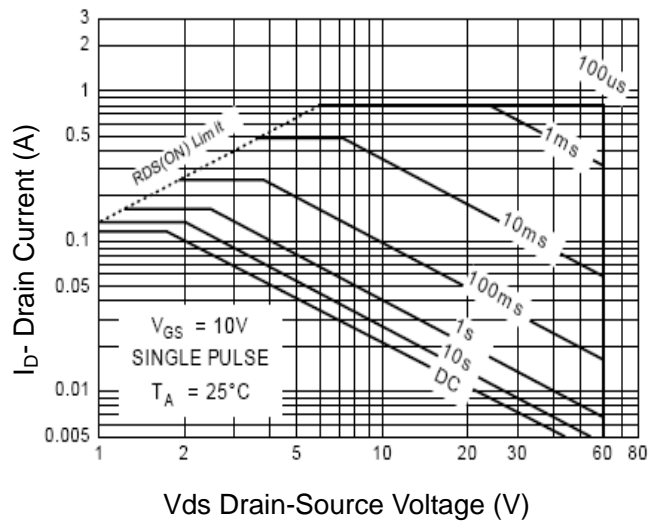


Figure 10 Safe Operation Area

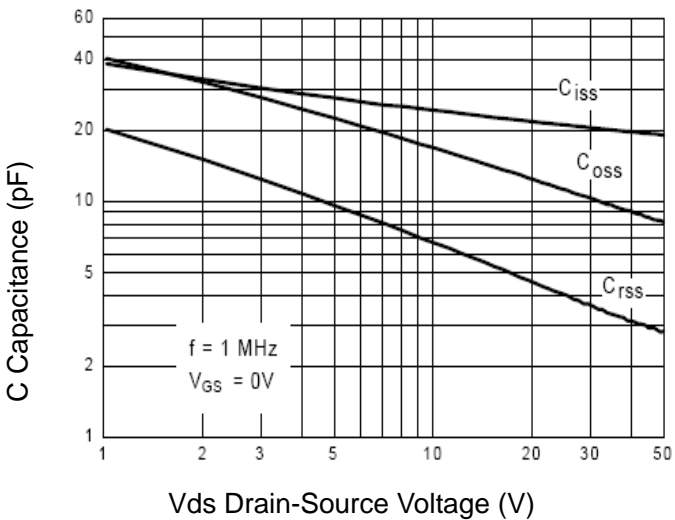


Figure 11 Capacitance vs Vds

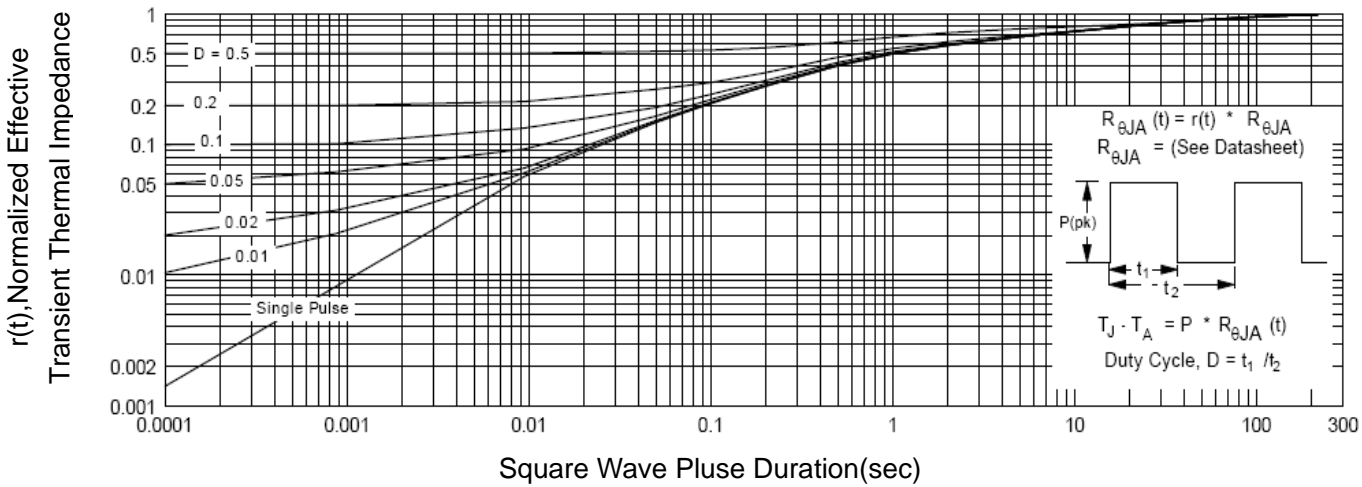
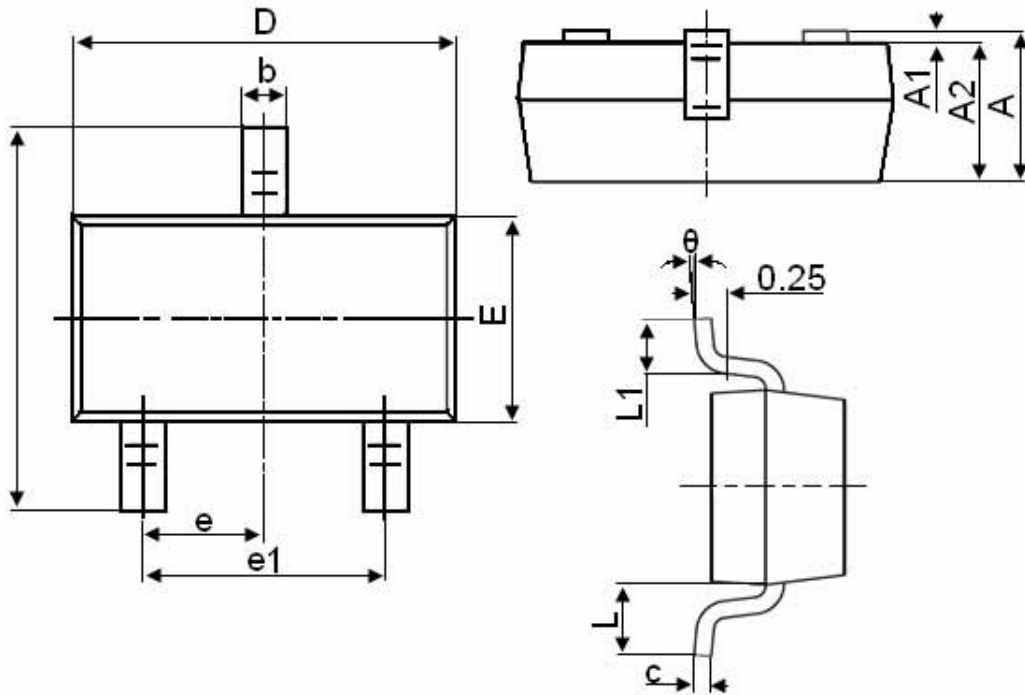


Figure 12 Normalized Maximum Transient Thermal Impedance

SOT-23 Package Information



| Symbol | Dimensions in Millimeters | |
|----------|---------------------------|-------|
| | MIN. | MAX. |
| A | 0.900 | 1.150 |
| A1 | 0.000 | 0.100 |
| A2 | 0.900 | 1.050 |
| b | 0.300 | 0.500 |
| c | 0.080 | 0.150 |
| D | 2.800 | 3.000 |
| E | 1.200 | 1.400 |
| E1 | 2.250 | 2.550 |
| e | 0.950TYP | |
| e1 | 1.800 | 2.000 |
| L | 0.550REF | |
| L1 | 0.300 | 0.500 |
| θ | 0° | 8° |

Notes

1. All dimensions are in millimeters.
2. Tolerance $\pm 0.10\text{mm}$ (4 mil) unless otherwise specified
3. Package body sizes exclude mold flash and gate burrs. Mold flash at the non-lead sides should be less than 5 mils.
4. Dimension L is measured in gauge plane.
5. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.